

حمل الآن

مجاناً وحصرياً

المراجعة رقم (1)

اختبار شهر اكتوبر



Questions

Chapter

1

Lesson One

Answered

Questions for the general stream and Al-Azhar students ?

Multiple choice questions (MCQ)



The mole and Avogadro's number

1 Number of the atoms in 0.5 mol of acetic acid CH_3COOH equals

- (a) Avogadro's number.
- (b) four times Avogadro's number.
- (c) double Avogadro's number.
- (d) eight times Avogadro's number.

2 How many moles of sodium in 7.53×10^{22} atoms of it ?

- (a) 1.25 mol
- (b) 0.125 mol
- (c) 0.062 mol
- (d) 0.625 mol

3 The number of ions found in 0.5 mol of K_2O equals

- (a) 3.01×10^{22} ions.
- (b) 3.01×10^{23} ions.
- (c) 9.03×10^{22} ions.
- (d) 9.03×10^{23} ions.

4 On dissolving 1 mol of sodium chloride in water completely, the total number of ions equals

- (a) Avogadro's number.
- (b) $2 \times$ Avogadro's number.
- (c) $3 \times$ Avogadro's number.
- (d) $4 \times$ Avogadro's number.

5 What is the number of ions found in 16 g of anhydrous copper (II) sulphate ?

- (a) 1.2×10^{23}
- (b) 3.61×10^{23}
- (c) 1.2×10^{24}
- (d) 3.61×10^{24}

[Cu = 63.5, S = 32, O = 16]

The mole and mass

6 A sample of oxygen gas whose mass is 8 g contains the same number of atoms found in 16 g of element (X).

What is the gram atomic mass of element (X) ?

[O = 16]

- (a) 4
- (b) 8
- (c) 16
- (d) 32

7 What is the molar mass of barium sulphite ?

[Ba = 137, S = 32, O = 16]

- (a) 217 g/mol
- (b) 233 g/mol
- (c) 354 g/mol
- (d) 514 g/mol

8 Which of the following has the least molar mass?

[H = 1, O = 16, C = 12, Cl = 35.5]

- (a) Water.
- (b) Carbon dioxide.
- (c) Methane.
- (d) Hydrogen chloride.

- 9 The number of moles of hydrogen sulphide in 49.79 g of it is [H = 1, S = 32]
 (a) 0.86 mol (b) 1.46 mol (c) 24.7 mol (d) 83.8 mol
- 10 What is the total number of moles of oxygen atoms found in 240 g of NH_4NO_3 ? [N = 14, O = 16, H = 1]
 (a) 3 mol (b) 6 mol
 (c) 9 mol (d) 27 mol
- 11 Mass of carbon in 2 mol of CaCO_3 is [C = 12]
 (a) 24 g (b) 12 g (c) 6 g (d) 0.48 g
- 12 The mass of 0.25 mol of sodium carbonate equals [Na = 23, C = 12, O = 16]
 (a) 23 g (b) 26.5 g (c) 53 g (d) 106 g
- 13 If the mass of 0.006 mol of an oxide of phosphorus equals 1.704 g
 What is the molecular formula of this oxide? [P = 31, O = 16]
 (a) P_2O_3 (b) PO_4 (c) P_4O_{10} (d) P_2O_4
- 14 Which of the following contains the least mass of oxygen?
 (a) 0.6 mol of HCOOH (b) 0.8 mol of H_2O
 (c) 0.7 mol of O_2 (d) 0.3 mol of H_2SO_4

The relation between number of substance moles, its mass and number of its particles

- 15 What is the number of the molecules in a sample of ammonia NH_3 its mass equals 43.5 g? [N = 14, H = 1]
 (a) 2.62×10^{25} molecules. (b) 2.36×10^{23} molecules.
 (c) 1.54×10^{24} molecules. (d) 8.63×10^{-16} molecules.
- 16 What is the mass of one molecule of propanol $\text{C}_3\text{H}_7\text{OH}$? [C = 12, H = 1, O = 16]
 (a) 9.97×10^{-23} g (b) 6.02×10^{23} g
 (c) 3.6×10^{-25} g (d) 60 g
- 17 1 mol of nitrogen gas N_2 combines with 3 mol of hydrogen gas H_2 to form the following amounts of NH_3 gas, except [N = 14, H = 1]
 (a) 2 mol (b) 34 g
 (c) $2 \times 6.02 \times 10^{23}$ molecules. (d) 17 g

18 4 g of sodium hydroxide contain

[Na = 23, O = 16, H = 1]

- (a) 6.02×10^{23} atoms of H (b) 4 g of Na
(c) 4 mol of NaOH (d) 6.02×10^{22} ions of Na

19 One mole of hydrogen gas (at STP) contains each of the following, except

[H = 1]

- (a) 6.02×10^{23} molecules of H_2 (b) 2 g of H_2
(c) 12.04×10^{23} atoms of H (d) 1 g of H_2

20 A sample of oxygen gas its mass is 32 g contains

[H = 1, O = 16]

- (a) 6.02×10^{23} oxygen atoms.
(b) 1.204×10^{24} oxygen molecules.
(c) the same number of oxygen atoms found in 18 g of water.
(d) the same number of oxygen atoms found in 36 g of water.

The mole and gas volume

21 The volume of 4 g of hydrogen gas at rtp equals

[H = 1]

- (a) 48 L (b) 44.8 L (c) 22.4 L (d) 2 L

22 Two balloons, one of them contains 0.5 mol of gas (A), and the other contains 3.01×10^{23} molecules of gas (B). Which of the following is correct at STP ?

- (a) The volume of (A) is double the volume of (B).
(b) The volume of (A) equals the volume of (B).
(c) The volume of (A) is less than the volume of (B).
(d) The volume of (A) is greater than the volume of (B).

23 The gas which the volume of 0.6 g of it = 80 mL at STP, its molar mass =

- (a) 340 g/mol (b) 310 g/mol (c) 168 g/mol (d) 85 g/mol

24 What is the mass of 0.25 L of the gas (X) at rtp whose molar mass = 62.7 g/mol ?

- (a) 0.65 g (b) 0.35 g (c) 0.07 g (d) 0.096 g

25 The largest mass of oxygen gas (at STP) among the following is the mass of [O = 16]

- (a) 1 molecule (b) 11.2 L (c) 1 mol (d) 1 atom

- 26** What is the mass of oxygen gas which occupies the same volume occupied by 3 mol of hydrogen gas (at STP) ? [O = 16]
- (a) 16 g (b) 32 g (c) 64 g (d) 96 g
- 27** The volume of 12.04×10^{23} molecules of hydrogen gas (at STP) equals
- (a) 89.6 L (b) 44.8 L (c) 22.4 L (d) 2 L
- 28** The highest number of molecules is found in [S = 32, O = 16]
- (a) 2.5 mol of H_2O (b) 33.6 L of N_2 gas at STP
(c) 60 g of SO_3 gas. (d) 3.01×10^{23} molecules of O_2 gas.
- 29** All the following are equivalent to 0.25 mol of nitrogen gas at rtp, except [N = 14]
- (a) 0.5 mol of atoms. (b) 3.01×10^{23} atoms.
(c) 7 g (d) 5.6 L
- 30** 1 liter of a given sample of air contains 5 g of chlorine gas.
Which of the following relations estimates the number of chlorine molecules in this volume of air ? [Cl = 35.5]
- (a) $71 \times \frac{5}{6.02 \times 10^{23}}$ (b) $\frac{5}{35.5} \times 6.02 \times 10^{23}$
(c) $5 \times \frac{1}{71} \times 6.02 \times 10^{23}$ (d) $\frac{5}{35.5} \times 71 \times 6.02 \times 10^{23}$
- 31** In the samples below :
- (1) 40 g of SO_3 (molar mass = 80 g/mol). (2) 12 L of CO_2 (at rtp).
(3) 2 mol of O atoms. (4) 6.02×10^{22} atoms of N
- The number of molecules is the same in the samples
- (a) (1) and (2) only. (b) (1), (2) and (4).
(c) (2) and (3) only. (d) (2), (3) and (4).
- 32** 1 mol of ammonia gas is similar to 1 mol of carbon dioxide gas (at STP) in
- (a) the volume only.
(b) the number of molecules only.
(c) the volume and the molar mass.
(d) the volume and the number of molecules.

- 33 Two balloons have the same volume (at STP), the first is filled with helium gas, and the other with argon gas.

Which of the following statements represents correctly both of them ?

- (a) Helium balloon contains higher number of atoms than argon balloon.
- (b) Helium balloon contains lower number of atoms than argon balloon.
- (c) Helium balloon contains the same number of atoms as argon balloon.
- (d) Helium balloon has higher mass than argon balloon.

- 34 Which of the following is an application of Avogadro's postulate (at rtp) ?

- (a) 11.2 L of O_2 gas contains the same number of molecules found in 11.2 L of H_2 gas.
- (b) 1 liter of Cl_2 gas contains the same number of atoms found in 1 liter of SO_2 gas.
- (c) The volume which is occupied by 26 g of C_2H_2 gas is larger than that occupied by 2 g of H_2 gas.
- (d) The volume of 1 mol of CH_4 gas is lower than the volume of 1 mol of NH_3 gas.

- 35 Two samples of O_2 and H_2 gases have the same volume at rtp, these samples are equal in

[H = 1, O = 16]

- (a) the number of moles only.
- (b) the mass and the number of molecules.
- (c) the number of molecules only.
- (d) both the numbers of moles and molecules.

Essay questions



- 36 Give reason for each of the following :

- (1) The mass of the mole (the molar mass) differs from one substance to another.
- (2) Number of atoms in 32 g of oxygen does not equal the number of atoms in 32 g of sulphur. [S = 32, O = 16]
- (3) One mole of each of CO and CO_2 contains the same number of molecules despite the difference of their molecular masses.
- (4) Number of atoms in 6 g of carbon equals the number of molecules in 14 g of carbon monoxide. [C = 12, O = 16]
- (5) The molar mass of oxygen gas molecules is double the molar mass of oxygen atoms.

The mole and Avogadro's number

- 37 Calculate the number of molecules of CO_2 in 0.2 mol of it.
- 38 Calculate the number of moles of potassium atoms whose number is 2.408×10^{24} atoms.

The mole and mass

- 39 Calculate the molar mass of : [C = 12, O = 16, H = 1, N = 14, Na = 23, Cl = 35.5, S = 32]

- | | | |
|-------------------|-----------------------------|------------------------------|
| (1) CO_2 | (2) NaCl | (3) HNO_3 |
| (4) SO_3 | (5) H_2SO_4 | (6) Na_2SO_4 |

- 40 Calculate the molar mass of lead element, knowing that the mass of 0.2 mol of it equals 41.4 g

- 41 What is the mass of oxygen found in 32.2 g of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ crystals?

[$\text{Na}_2\text{SO}_4 = 142 \text{ g/mol}$, $\text{H}_2\text{O} = 18 \text{ g/mol}$, $\text{O} = 16$]

The relation between number of substance moles, its mass, and number of its particles

- 42 If the mass of 0.5 mol of the compound WCl_2 equals 125 g :

- (1) Calculate the number of moles of chloride ions in a sample of this compound
its mass = 250 g

- (2) Calculate the molar mass of the compound WBr_2 [Cl = 35.5, Br = 80]

- 43 Calculate the number of atoms found in 28 g of butene C_4H_8 [C = 12, H = 1]

- 44 Calculate the number of the molecules of carbon dioxide gas found in 4.4 g of it. [C = 12, O = 16]

- 45 Calculate the number of the ions produced from dissolving 1.6 g of sodium carbonate in water. [Na = 23, C = 12, O = 16]

- 46 Calculate the number of moles of chloride ions found in an aqueous solution containing 811.75 g of iron (III) chloride salt. [Fe = 55.85, Cl = 35.5]

- 47 Calculate the mass of sodium carbonate which contains 1.773×10^{17} carbon atoms.

[Na = 23, C = 12, O = 16]

- 48 Calculate the mass of 100 atoms of copper (in grams). [Cu = 63.55]

- 49 The mass of a drop of ethyl alcohol ($\text{C}_2\text{H}_5\text{OH} = 46 \text{ g/mol}$) is $2.3 \times 10^{-3} \text{ g}$

Calculate the number of the alcohol molecules in one drop.

The mole and gas volume

50 Which has a bigger volume (at STP) :

64.4 g of nitrogen gas or 67.2 g of oxygen gas ?

[N = 14 , O = 16]

Illustrate your answer with calculations.

51 4 balloons are inflated with four different gases (at rtp), the mass of :

- Hydrogen gas in the first balloon was 0.02 g
- Helium gas in the second balloon was 0.04 g
- Neon gas in the third balloon was 0.2 g
- Oxygen gas in the fourth balloon was 0.32 g

Arrange these balloons according to their volumes, explain your answer with chemical calculations.

[H = 1 , He = 4 , Ne = 20 , O = 16]

52 Calculate the volume of 2.5 mol of O_2 gas at STP.

53 How many carbon atoms are found in 5.6 L of ethane gas C_2H_6 at rtp ?

54 A balloon is inflated with 0.036 g of helium gas [He = 4], so the volume of the balloon becomes X L at STP

What is the mass of hydrogen gas [H = 1] required to inflate another balloon to the same volume X L at the same temperature and pressure ?

55 An amount of chlorine gas its volume equals 311.36 L at STP

Calculate the number of molecules of fluorine found in the same volume as that of chlorine at the same temperature and pressure.

Higher – order questions

Answered in detail

Choose the correct answer :

56 If the molar mass of $M(OH)_3$ equals 78 g/mol, so the gram atomic mass of the element (M) equals

[O = 16 , H = 1]

- (a) 62 g (b) 59 g (c) 30 g (d) 27 g

57 • Element (X) its gram atomic mass is 32 g/mol and its electronic configuration is (2 , 8 , 6). • Element (Y) its gram atomic mass is 35.5 g/mol and its electronic configuration is (2 , 8 , 7). What is the molar (gram molecular) mass of the compound produced from combining the atoms of the two elements (X) and (Y) ?

- (a) 67 g/mol (b) 99 g/mol (c) 103 g/mol (d) 134 g/mol

58 What is the gas which the mass of 0.2 mol of it equals 12.8 g ? [S = 32, C = 12, O = 16, N = 14, H = 1]

- (a) SO₂ (b) CO (c) CO₂ (d) NH₃

59 Which of the following samples contains the same number of moles of CaSO₄ in 272 g of it ?

[Ca = 40, S = 32, Cl = 35.5, O = 16, N = 14, H = 1]

- (a) 142 g of chlorine gas. (b) 40 g of oxygen gas.
(c) 7 g of nitrogen gas. (d) 2 g of hydrogen gas.

60 The compound which the mass of its molecule = 133×10^{-24} g, its molar mass equals

- (a) 44 g/mol (b) 64 g/mol (c) 80 g/mol (d) 100 g/mol

61 If the mass of one molecule of the substance (X) equals 4.65×10^{-23} g

Which of the following represents the substance (X) ?

[N = 14, O = 16, F = 19, Cl = 35.5]

- (a) N₂ (b) O₂ (c) Cl₂ (d) F₂

62 What is the mass of a sample of aluminum (in grams) which contains half Avogadro's number of atoms ?

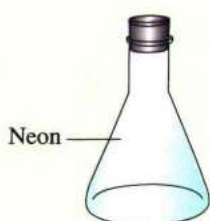
[Al = 27]

- (a) 6.75 g (b) 13.5 g (c) 27 g (d) 54 g

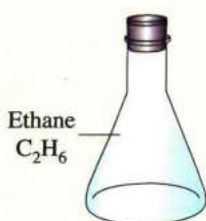
63 Here are four identical flasks which contain equal amounts of different gases at the same conditions of temperature and pressure.

Which of these flasks is the largest in mass ?

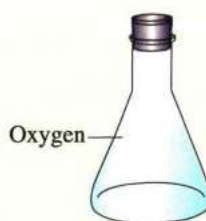
[Ne = 20, C = 12, H = 1, O = 16, N = 14]



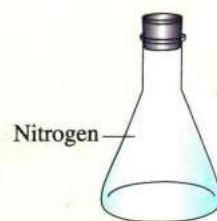
(a)



(b)



(c)



(d)

Essay questions :

64 What is the length of the line (in meters) which results from arranging the atoms of carbon which are present in 0.12 g of it, knowing that the diameter of carbon atom is 0.7×10^{-7} m ?

[C = 12]

65 The internal volume of a metallic cylinder is 30 L, it contains 32 g of gas (X) (at STP).

Can gas (X) be oxygen gas O₂ or methane gas CH₄ ? Explain.

[C = 12, H = 1, O = 16]

Multiple choice questions (MCQ)



Masses of substances calculations

- 1 What is the mass of aluminum in 306 g of aluminum oxide Al_2O_3 ?

[Al = 27, O = 16]

- (a) 81 g (b) 162 g
(c) 200 g (d) 243 g

- 2 What is the mass of sodium chloride which contains 5.75 g of sodium ? [Na = 23, Cl = 35.5]

- (a) 117 g (b) 58.5 g (c) 29.25 g (d) 14.63 g

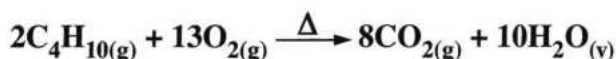
- 3 What is the mass of the substance produced from the complete burning of a strip of magnesium whose mass equals 12 g in air ?

[Mg = 24, O = 16]

- (a) 12 g (b) 20 g (c) 40 g (d) 56 g

Number of moles calculations

- 4 Butane burns according to the equation :



What is the number of moles of carbon dioxide gas produced from burning 3 mol of butane gas (C_4H_{10}) ?

- (a) 4 mol (b) 8 mol (c) 12 mol (d) 24 mol

- 5 From the reaction equation : $4\text{NH}_{3(\text{g})} + 7\text{O}_{2(\text{g})} \longrightarrow 4\text{NO}_{2(\text{g})} + 6\text{H}_2\text{O}_{(\text{v})}$

What is the least number of moles of oxygen required to oxidize 16 mol of ammonia gas ?

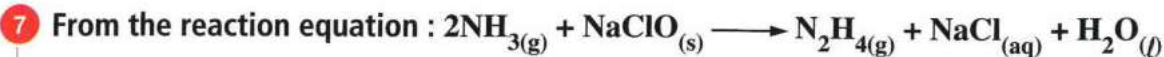
- (a) 16 mol (b) 28 mol (c) 64 mol (d) 80 mol

- 6 In the reaction : $3\text{Mg} + \text{N}_2 \xrightarrow{\Delta} \text{Mg}_3\text{N}_2$

What is the number of moles of nitrogen gas which react with 18 g of magnesium to form magnesium nitride compound ?

[Mg = 24, N = 14]

- (a) 0.25 mol (b) 0.5 mol (c) 1 mol (d) 2 mol

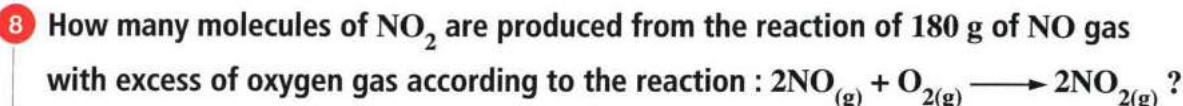


What are the number of moles and the mass of N_2H_4 produced from the reaction of 34 g of NH_3 ?

[N = 14, H = 1]

- (a) 1 mol / 18 g (b) 2 mol / 36 g (c) 2 mol / 64 g (d) 1 mol / 32 g

Number of particles calculations



- (a) 1.204×10^{24} molecules. (b) 1.806×10^{24} molecules. [NO = 30 g/mol]
(c) 3.612×10^{24} molecules. (d) 7.224×10^{24} molecules.

Volumes of gases calculations

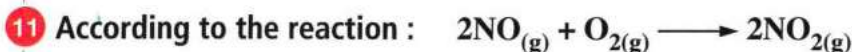
9 The volume of hydrogen gas (at rtp) which is required to produce 12 L of water vapour equals

- (a) 6 L (b) 12 L (c) 48 L (d) 24 L

10 What is the volume (at STP) of the gas produced from the reaction of 4.6 g of sodium [Na=23] with excess of water according to the equation :



- (a) 1.12 L (b) 2.24 L (c) 4.48 L (d) 11.2 L

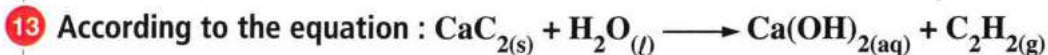


What is the volume of NO_2 gas which is produced from the reaction of 30 mL of NO gas with excess of oxygen gas at the same temperature and pressure ?

- (a) 10 mL (b) 15 mL (c) 0.003 L (d) 0.03 L

12 What is the volume of H_2 gas (at STP) which is produced from the reaction of 12.15 g of magnesium [Mg = 24] with excess hydrochloric acid ?

- (a) 1 L (b) 2 L (c) 5.6 L (d) 11.34 L



Upon the reaction of 6.4 g of CaC_2 with water completely, the volume of the produced gas is estimated (at STP) from the relation

[Ca = 40, C = 12]

- (a) $\frac{64 \times 6.4}{31}$ (b) $\frac{22.4}{64 \times 6.4}$ (c) $6.4 \times 64 \times 22.4$ (d) $\frac{6.4 \times 22.4}{64}$

The limiting reactant

- 14 Substance (A) reacts with substance (B) according to the equation :



What is the limiting reactant of the reaction of 2 mol of (A) with 1 mol of (B) ?

- (a) A (b) B (c) C (d) D

- 15 On mixing two equal masses of H_2 and O_2 gases at suitable conditions for the formation of H_2O , the limiting reactant of this reaction will be [H = 1, O = 16]

- (a) O_2 only. (b) H_2 only. (c) O_2 and H_2O (d) H_2 and H_2O

- 16 In the reaction : $2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$

When 2 mol of oxygen gas are mixed with 2 g of sulphur dioxide gas (at the required conditions), the limiting reactant of this reaction is [S = 32, O = 16]

- (a) $SO_{2(g)}$ (b) $SO_{3(g)}$ (c) $O_{2(g)}$ (d) none.

- 17 In the reaction : $NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$

Adding 12.04×10^{23} molecules of NaOH to an amount of HCl yields 18 g of water.

What is the limiting reactant in this reaction ? [Na = 23, O = 16, H = 1]

- (a) NaOH (b) NaCl (c) HCl (d) H_2O

- 18 In the reaction : $AlCl_{3(aq)} + 3NaOH_{(aq)} \longrightarrow Al(OH)_{3(s)} + 3NaCl_{(aq)}$

When 2 mol of aluminum chloride are added to 3 mol of sodium hydroxide.

What is the number of moles of the substance remaining at the end of the reaction ?

- (a) 1.5 mol (b) 1 mol (c) 0.5 mol (d) Zero.

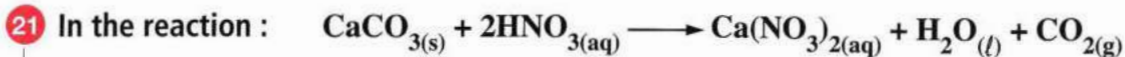
- 19 What is the mass of water vapour produced from adding 4 mol of O_2 to 2 mol of H_2 at suitable conditions ? [H = 1, O = 16]

- (a) 18 g (b) 36 g (c) 72 g (d) 108 g

- 20 According to the equation : $6Li_{(s)} + N_{2(g)} \longrightarrow 2Li_3N_{(s)}$

What is the mass of the substance produced from the reaction of 3.5 g of each of the two reactants together ? [Li = 7, N = 14]

- (a) 3.52 g (b) 2.93 g (c) 17.6 g (d) 5.83 g

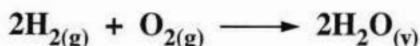


0.08 mol of nitric acid is added to 0.05 mol of calcium carbonate.

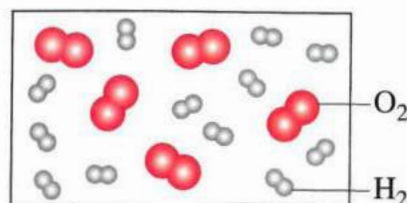
Which of the following is correct after the end of the reaction ?

- (a) 0.05 mol of CO_2 is produced. (b) 0.08 mol of $\text{Ca}(\text{NO}_3)_2$ is produced.
(c) 0.01 mol of CaCO_3 remains unreacted. (d) 0.03 mol of HNO_3 remains unreacted.

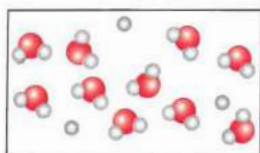
- 22 Hydrogen gas reacts with oxygen gas, according to the equation :



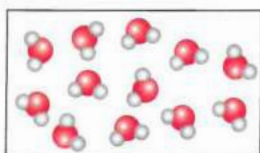
If we have the mixture shown in the figure.



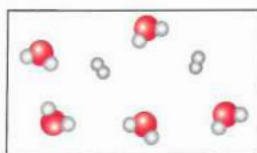
Which of the following represents the mixture produced after the end of the reaction ?



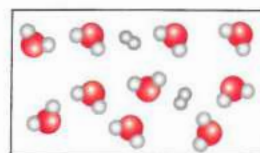
(a)



(b)



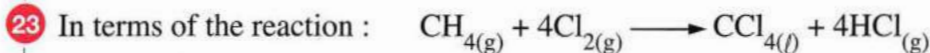
(c)



(d)

Essay questions

Masses of substances calculations



What is the mass of CCl_4 which is produced from the reaction of 5.14 g of methane gas with excess of chlorine gas ?

[C = 12, H = 1, Cl = 35.5]

- 24 Calculate the mass of hydrogen gas produced from the reaction of 0.23 g of sodium metal with water according to the equation :



[Na = 23, H = 1]

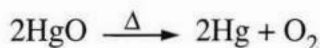
Number of moles calculations

- 25 Calculate the mass of sulphur required to react with 6.2 mol of iron to form iron (II) sulphide.

[S = 32]

- 26 Calculate the number of moles of oxygen gas produced from heating 108.25 g of red mercury oxide, according to the equation :

[Hg = 200.95, O = 16]

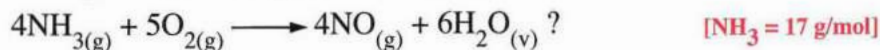


- 27 Calculate the number of moles of H_2SO_4 which can be prepared from 3 g of Cu_2S , if each sulphur atom in it is converted into H_2SO_4 molecule.

[Cu = 63.5, S = 32]

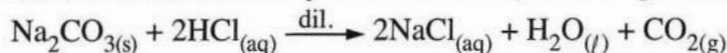
Number of particles calculations

- 28 How many nitric oxide molecules are produced from the reaction of 119 g of ammonia with excess of oxygen, according to the reaction :



Volumes of gases calculations

- 29 Sodium carbonate reacts with dilute hydrochloric acid, according to the equation :



Calculate the volume of CO_2 gas (at STP) which is produced from the reaction of 0.02 mol of sodium carbonate with excess of hydrochloric acid.

- 30 In the reaction of 11.5 g of sodium with excess of water

according to the equation : $2\text{Na}_{(s)} + 2\text{H}_2\text{O}_{(l)} \longrightarrow 2\text{NaOH}_{(aq)} + \text{H}_{2(g)}$

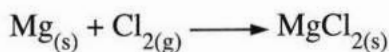
Calculate :

(1) The volume of hydrogen gas (at STP) which is produced from this reaction.

(2) The number of sodium ions which are produced from this reaction. [Na = 23, H = 1]

- 31 Calculate the mass of magnesium required for the reaction with dilute sulphuric acid to produce 22.4 L of hydrogen (at rtp). [Mg = 24]

- 32 Magnesium reacts with chlorine yielding magnesium chloride, as follows:



Calculate the volume of chlorine gas (at STP) required to react completely with 0.6 g of magnesium. [Mg = 24]

- 33 Calculate the molar mass of each of the following gases:

(1) The volume of 0.8 g of gas (X) at STP equals 560 mL

(2) The mass of 1.12 L of gas (Y) at STP equals 1.5 g

The limiting reactant

- 34 In the reaction : $4\text{NH}_{3(g)} + 5\text{O}_{2(g)} \longrightarrow 4\text{NO}_{(g)} + 6\text{H}_2\text{O}_{(v)}$

Conclude the limiting reactant of the reaction on mixing 2 g of ammonia gas with 6 g of oxygen gas at suitable conditions for the reaction. [N = 14, H = 1, O = 16]

- 35 In the reaction : $\text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2\text{SO}_4 \longrightarrow 3\text{CaSO}_4 + 2\text{H}_3\text{PO}_4$

129 g of $\text{Ca}_3(\text{PO}_4)_2$ are added to 4.49 g of H_2SO_4

State (by using chemical calculations) the limiting reactant of this reaction.

[$\text{Ca}_3(\text{PO}_4)_2 = 310 \text{ g/mol}$, $\text{H}_2\text{SO}_4 = 98 \text{ g/mol}$]

- 36 15 g of lithium Li react with 15 g of fluorine gas F_2 , as follows :



Calculate the mass of :

[Li = 7, F = 19]

- (1) The product of this reaction.
- (2) The remaining substance without reaction.

- 37 In terms of the reaction : $2Al_{(s)} + 6HCl_{(g)} \longrightarrow 2AlCl_{3(s)} + 3H_{2(g)}$

If the reaction vessel contains 0.15 mol of Al with 0.33 mol of HCl

Calculate the possible number of the produced moles of $AlCl_3$

- 38 Calculate the mass of P_4O_{10} which can be obtained through adding 1.33 g of P_4 to 5 g of O_2 at suitable reaction conditions.

[P = 31, O = 16]

Higher – order questions

Answered in detail

Choose the correct answer :

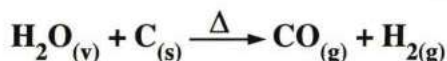
- 39 Two atoms of rubidium Rb combine with one atom of oxygen O to form rubidium oxide.

What is the mass of rubidium oxide which is produced from the reaction of 1.98 g of rubidium with excess of oxygen gas ?

[Rb = 85.5, O = 16]

- (a) 1.81 g (b) 2.17 g (c) 4.3 g (d) 8.6 g

- 40 On passing water vapour over red hot coke, the following reaction occurs :



What is the number of moles of the gases remaining in the reaction medium when 18 g of water vapour react with excess coke "assuming that the reaction container is closed" ?

[H = 1, O = 16, C = 12]

- (a) 0.5 mol (b) 1 mol (c) 2 mol (d) 3 mol

- 41 12.4 g of metal (X) react with nitrogen gas [N = 14] forming 31.7 g of the compound X_3N_2

What is the number of the reacting moles of metal (X) ?

- (a) 4.5 mol (b) 5.8 mol (c) 2.07 mol (d) 2.5 mol

- 42 Two closed vessels contain chlorine gas at the same conditions of temperature and pressure, so if the first vessel whose volume = 1.3 L contains 6.7 mol of gas. What is the number of moles in the second vessel whose volume = 2.33 L ?
- (a) 0.452 mol (b) 3.74 mol (c) 12 mol (d) 20.3 mol

- 43 In terms of the equation : $\text{CH}_{4(g)} + 2\text{O}_{2(g)} \xrightarrow{\Delta} \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(v)}$

Which of the following is the sum of the volumes of the gas and the vapour (at STP) produced from burning 5 g of methane gas CH_4 ?

[C = 12, H = 1]

- (a) 5 L (b) 7 L (c) 14 L (d) 21 L

- 44 20 mL of CO gas burn in 40 mL of O_2 gas in a closed piston according to the equation :
- $$2\text{CO}_{(g)} + \text{O}_{2(g)} \xrightarrow{\Delta} 2\text{CO}_{2(g)}$$

What is the total volume of the gases (at STP) in the piston after the end of the reaction ?

- (a) 20 mL (b) 40 mL (c) 50 mL (d) 80 mL

Essay question :

- 45 From the reaction equation : $\text{C}_2\text{H}_{4(g)} + 3\text{O}_{2(g)} \longrightarrow 2\text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(g)}$

What is the total number of moles of the gases produced upon mixing 1 mol of C_2H_4 with 4 mol of O_2 at suitable reaction conditions ?

Questions

Chapter

1

Lesson Three

Answered

Questions for the general stream and Al-Azhar students ?

Multiple choice questions (MCQ)



Calculation of the chemical formula

1 The empirical formula of $C_4H_8O_2$ is

- (a) $C_4H_4O_2$ (b) C_2H_4O
(c) $C_2H_8O_2$ (d) C_4H_8O

2 What is the empirical formula of the compound whose molecular formula is $C_6H_3(NO_3)_3$?

- (a) CHNO (b) C_2HNO_3 (c) $(C_2HNO_2)_3$ (d) $C_6H_3N_3O_6$

3 All the following compounds have the empirical formula CH_2O , except

- (a) HCHO (b) CH_3COOH (c) $(COOH)_2$ (d) $C_6H_{12}O_6$

4 The empirical formula of the acid CH_3COOH is the same empirical formula of the compound

- (a) HCOOH (b) $C_2H_4(OH)_2$ (c) $C_6H_{12}O_6$ (d) C_2H_5OH

5 Number of units of the empirical formula in $C_2H_2O_4$ =

- (a) 1 (b) 2 (c) 3 (d) 4

6 Which of the following is considered an empirical formula ?

- (a) N_2O_4 (b) C_3H_6 (c) NH_3 (d) C_4H_8

7 The compound that each molecule of it consists of 3 atoms of carbon, 6 atoms of hydrogen and 1 atom of oxygen, its molecular formula is

- (a) $(CH)_3OH$ (b) C_6H_3O (c) $(CH_3)_2CO$ (d) $(CH_3)_2O$

Calculation of the empirical formula

8 Which of the following compounds its empirical formula has the largest molar mass ?

- (a) C_6H_6 (b) C_4H_{10} [C = 12, H = 1]
(c) C_3H_6 (d) C_2H_6

9 What is the chemical formula of the oxide of nitrogen which contains 63.64% by mass nitrogen ?

- (a) NO (b) N_2O [N = 14, O = 16]
(c) NO_2 (d) N_2O_4

- 10 What is the empirical formula of the oxide of sulphur which contains 50% by mass sulphur ? [S = 32, O = 16]
- (a) SO_3 (b) SO_2 (c) S_2O_4 (d) SO
- 11 A compound consists of 3 elements in the following percentages :
 • C = 72% • H = 12% • O = 16%
 What is the ratio of the number of moles of carbon (C) : the number of moles of hydrogen (H) in the empirical formula of this compound ? [C = 12, H = 1, O = 16]
- (a) 1 : 1 (b) 1 : 2 (c) 1 : 6 (d) 6 : 1
- 12 A sample of an unknown compound its mass is 33.2 g and is composed of oxygen and vanadium elements.
 What is the chemical formula of this compound, if the mass of oxygen in the previous sample is 14.6 g ? [V = 51, O = 16]
- (a) VO_2 (b) V_2O_5 (c) V_2O_3 (d) V_3O_2
- 13 0.23 g of compound (X) combusts (burns) in excess of oxygen gas giving 0.22 g of CO_2 and 0.09 g of H_2O
 What is the empirical formula of the compound (X) ? [C = 12, H = 1, O = 16]
- (a) CH_2O_3 (b) CHO (c) CH_2O_2 (d) CHO_2
- 14 1 mol of hydrocarbon (X) gives upon complete combustion 3 mol of CO_2 and 3 mol of H_2O
 What is the empirical formula of the hydrocarbon (X) ? [C = 12, H = 1, O = 16]
- (a) CH_2 (b) C_3H_6 (c) CH_3 (d) C_2H_3
- Calculation of the molecular formula*
- 15 Which of the following represents a chemical compound whose molecular molar mass equals its empirical molar mass ?
- (a) C_4H_6 (b) N_2H_4 (c) K_2O_2 (d) V_2O_5
- 16 If the empirical formula of a compound is CH_2 and its molar mass is 56 g/mol, so its molecular formula is [C = 12, H = 1]
- (a) C_2H_4 (b) C_3H_6 (c) C_4H_8 (d) C_5H_{10}
- 17 The compound which is composed of 55.8% carbon, 7.03% hydrogen and 37.17% oxygen, and its molecular formula is composed of 2 units of its empirical formula, has the molecular formula [C = 12, H = 1, O = 16]
- (a) CHO (b) $\text{C}_2\text{H}_3\text{O}$ (c) $\text{C}_4\text{H}_6\text{O}_2$ (d) $\text{C}_6\text{H}_{12}\text{O}_6$

18 The molar mass of an unknown compound is 148.5 g/mol, it is composed of 24.24% carbon, 4.04% hydrogen, and the rest is of chlorine.

What is the molecular formula of this compound ?

[C = 12, H = 1, Cl = 35.5]

- (a) $C_6H_{12}Cl_6$ (b) CH_2Cl (c) $C_3H_6Cl_3$ (d) $C_4H_8Cl_4$

19 An organic compound with empirical formula $CHCl$, and its molar mass = 291 g/mol

What is the number of moles of the atoms in one mole of this compound ?

- (a) 3 mol of atoms. (b) 6 mol of atoms. [C = 12, H = 1, Cl = 35.5]
(c) 12 mol of atoms. (d) 18 mol of atoms.

20 The complete combustion of a hydrocarbon in excess of oxygen gas yields 7.8 g of CO_2 and 4.2 g of H_2O

What is the mass of each of C and H in this hydrocarbon ?

[C = 12, H = 1, O = 16]

- (a) C : 28.6 g, H : 0.47 g (b) C : 2.127 g, H : 37.8 g
(c) C : 28.6 g, H : 37.8 g (d) C : 2.127 g, H : 0.47 g

21 10.6 g sample of a hydrocarbon yields through complete combustion 35.86 g of CO_2 and 7.38 g of H_2O , the molar mass of this hydrocarbon is 104 g/mol

How many moles of hydrogen atoms are found in 1 mol of this hydrocarbon ? [C = 12, H = 1, O = 16]

- (a) 18 (b) 16 (c) 14 (d) 8

22 264 g of strontium element Sr react completely with 213 g of chlorine to form a compound its molecular formula is

[Sr = 87.6, Cl = 35.5]

- (a) $SrCl$ (b) $SrCl_2$ (c) $SrCl_3$ (d) Sr_2Cl

Molarity

23 The molarity is estimated in

- (a) g/L (b) mol/L (c) L/mol (d) mol/100 g

24 What is the molarity of the solution which 100 mL of it contain 0.006 mol of NaCl ?

- (a) 0.6 M (b) 0.066 M (c) 0.06 M (d) 0.006 M

25 When 0.5 mol of potassium hydroxide is dissolved in an amount of water to form 250 mL of a solution, the concentration will be

- (a) 2 M (b) 8 M (c) 0.2 mol/L (d) 0.08 mol/L

- 26** 16.4 g of hydrogen fluoride are dissolved in an amount of water to form 2×10^2 mL of a solution.
What is the concentration of the resulting solution ? [H = 1, F = 19]
- (a) 0.82 M (b) 0.16 M (c) 0.08 M (d) 4.1 M
- 27** What is the number of moles of sodium hydroxide found in 2 L of a solution of it, its concentration is 5 M ?
- (a) 2.5 mol (b) 5 mol (c) 7 mol (d) 10 mol
- 28** Which of the following solutions of sodium chloride contains the highest number of moles of the solute ?
- (a) 10 mL of 0.5 mol/L solution. (b) 20 mL of 0.4 mol/L solution.
(c) 30 mL of 0.3 mol/L solution. (d) 40 mL of 0.2 mol/L solution.
- 29** A liter of 0.25 M solution of caustic soda NaOH contains each of the following of NaOH, except [Na = 23, O = 16, H = 1]
- (a) 10 g (b) 40 g
(c) 0.25 mol (d) 1.505×10^{23} molecules.
- 30** What is the mass of calcium chloride which is required to form 500 mL of an aqueous solution with concentration 0.2 M ? [Ca = 40, Cl = 35.5]
- (a) 1.11 g (b) 11.1 g (c) 111 g (d) 11100 g
- 31** The mass of potassium hydroxide which is required to prepare 200 mL of 0.5 M solution equals [K = 39, O = 16, H = 1]
- (a) 28 g (b) 14 g (c) 6.5 g (d) 5.6 g
- 32** What is the volume of NaCl solution which contains 0.06 mol of the solute and its concentration = 0.3 M ?
- (a) 0.018 L (b) 0.2 L (c) 0.5 L (d) 5 L
- 33** An aqueous solution of sucrose (its molar mass = 342 g/mol) contains 123 g of the solute and its molar concentration = 0.55 M
What is the volume of this solution ?
- (a) 66 mL (b) 220 mL (c) 340 mL (d) 654 mL

- 34 What is the molar concentration of the solution which results from dissolving $\frac{1}{4}$ Avogadro's number of solute molecules in an amount of water to form 250 mL of it ?

(a) 2 M (b) 1 M (c) 0.5 M (d) 0.25 M

- 35 The given table presents the molar masses of 4 substances, when 10 g of one of these substances dissolve in water forming 500 mL solution, the concentration of this solution becomes 0.5 M

Substance	CaCl ₂	Ca(OH) ₂	KOH	NaOH
Molar mass (g/mol)	111	74	56	40

What is the dissolved substance ?

(a) CaCl₂ (b) Ca(OH)₂ (c) KOH (d) NaOH

- 36 What is the concentration of sodium ions in 500 mL of a solution in which 71 g of sodium sulphate salt are dissolved ?

[Na = 23, S = 32, O = 16]

(a) 8 M (b) 6 M (c) 4 M (d) 2 M

- 37 How many ions are produced from dissolving an amount of potassium phosphate in water to form 0.25 L of 2 M solution ?

(a) 3.01×10^{23} ions. (b) 6.02×10^{23} ions.
(c) 9.03×10^{23} ions. (d) 12.04×10^{23} ions.

Dilution of solutions

- 38 What is the concentration of the solution which is produced from mixing 75 mL of 0.05 M HCl solution with 25 mL of 3 M HCl solution ?

(a) 0.375 M (b) 0.393 M (c) 0.75 M (d) 0.7875 M

- 39 5 mol/L sulphuric acid was diluted from 1 L to 10 L
What is the molar concentration of the dilute acid ?

(a) 0.1 M (b) 0.5 M (c) 1 M (d) 5 M

- 40 10 mL of 6 M hydrochloric acid were diluted with water until the concentration became 0.5 M

What is the volume of the added water ?

(a) 50 mL (b) 110 mL (c) 120 mL (d) 290 mL

- 41 50 mL of 0.5 M iron (III) sulphate solution are mixed with 150 mL of 1.5 M solution of the same substance.
What is the molar concentration of this mixture ?
(a) 0.025 M (b) 0.2 M (c) 0.22 M (d) 1.25 M
- 42 What is the concentration of sodium carbonate solution formed by adding 240 cm³ of water to 10 cm³ of 0.8 M solution of it ?
(a) 0.016 M (b) 0.032 M (c) 0.04 M (d) 0.064 M
- 43 When 50 mL volume of 1.74 M solution is diluted with water to form 150 mL, its concentration changes to
(a) 0.58 M (b) 1 M (c) 1.2 M (d) 1.42 M
- 44 Upon the dilution of 5 L of 0.6 M solution with water, its concentration becomes 0.4 M
What is the volume of the dilute solution?
(a) 6 L (b) 7.5 L (c) 1.5 L (d) 5 L
- 45 What is the number of moles of an acid its concentration is 3 M which are found in 1 L of it ? What is the number of its moles when a liter of water is added to 1 L of it, respectively ?
(a) 0.33 mol / 0.33 mol (b) 0.33 mol / 0.11 mol
(c) 3 mol / 3 mol (d) 3 mol / 1.5 mol

Essay questions



- 46 Give reasons for :

- (1) Empirical formula may not represent the chemical composition of the compound.
- (2) The molecular formula of aluminum sulphate is the same as its empirical formula.

Calculation of the empirical and the molecular formulas

- 47 Calculate the molar mass of the empirical formula of each of the following compounds :

[C = 12, O = 16, H = 1, Si = 28, Cl = 35.5]

(1)	(2)
O = C = O	$ \begin{array}{c} \text{Cl} \quad \text{Cl} \\ \quad \\ \text{Cl} - \text{Si} - \text{Si} - \text{Cl} \\ \quad \\ \text{H} \quad \text{H} \end{array} $

48 What is the empirical formula of the hydrocarbon which contains 0.5 mol of carbon and 1 mol of hydrogen ?

49 Conclude by using the chemical calculations the empirical formula of the compound which contains oxygen in a percentage of 94.12% and hydrogen in a percentage of 5.88%
[H = 1 , O = 16]

50 The mass of a pure sample of a certain compound is 80 g, this mass contains 32 g of sulphur and the rest of it is oxygen .
Estimate the empirical formula of this compound. [S = 32 , O = 16]

51 What is the molecular formula of a compound whose molar mass is 78 g/mol, and its empirical formula is NaO ? [Na = 23 , O = 16]

52 What is the molecular formula of a compound whose molar mass is 70 g/mol, knowing that it contains 85.7% of carbon and 14.3% of hydrogen ? [C = 12 , H = 1]

53 A compound is composed of sulphur and fluorine elements, its molar mass is 102 g/mol, and the mass percentage of sulphur in it is 62.79%
Conclude by calculations the molecular formula of this compound. [S = 32 , F = 19]

54 A sample of an organic compound its mass is 10.2 g contains carbon, hydrogen and oxygen, and produces, through its combustion in excess oxygen, 23.1 g of CO₂ and 4.72 g of H₂O
Conclude mathematically the empirical formula of the compound. [C = 12 , H = 1 , O = 16]

55 Hydrazine is composed of nitrogen and hydrogen elements :

(1) Write each of its :

1– Empirical formula.

2– Molecular formula.

(2) Calculate the molar mass of hydrazine.

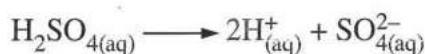
(3) Calculate the number of hydrogen atoms in 10 g of hydrazine. [N = 14 , H = 1]

Molarity

56 When does the molar concentration of a solution equal 1 M ?

- 57 Calculate the molarity of a solution whose volume is 3 L and contains 0.5 mol of silver nitrate.
- 58 Calculate the molarity of 200 mL of solution formed by dissolving 20 g of NaOH in water. [Na = 23 , O = 16 , H = 1]
- 59 Calculate the mass of sodium carbonate found in 750 mL of 0.4 M solution of it. [Na₂CO₃ = 106 g/mol]
- 60 Calculate the volume of 0.5 M BaCl₂ solution which contains 3 mol of chloride ions.
- 61 Calculate the mass of NH₄Cl required to prepare an aqueous solution its volume is 100 mL, each 1 mL of it contains 70 mg of solute. [N = 14 , H = 1 , Cl = 35.5]
- 62 Calculate the volume of 0.14 M sodium chloride solution which contains 1 mg of NaCl [Na = 23 , Cl = 35.5]

- 63 Sulphuric acid ionizes in water according to the following equation :



Calculate the concentration of each of H⁺_(aq) , SO²⁻_{4(aq)} ions in 0.3 M solution.

- 64 Calculate the volume of 0.3 M Na₂SO₄ solution required to prepare 2 L of solution of Na₂SO₄ in which the concentration of Na⁺ ions is 0.4 M

Dilution of solutions

- 65 What is the molar concentration of the dilute solution resulting from adding 200 mL of distilled water to 50 mL of 0.2 M HCl acid ?
- 66 Calculate the volume of 2 M hydrochloric acid required to prepare 250 cm³ of 0.15 M solution of it.
- 67 What is the volume of water required to be added to 12 M HCl solution to obtain 300 mL of a dilute solution of it of concentration 5 M ?
- 68 Calculate the concentration of the solution resulting from adding 100 mL of 0.1 M sodium chloride solution to 400 mL of 0.2 M of sodium chloride solution.

Higher – order questions



Answered in detail

Choose the correct answer :

- 69 What is the empirical formula of the compound which is composed of the elements X, Y and Z in equal mass percentages ? [X = 20, Y = 40, Z = 60]
- (a) X_3Y_2Z (b) XY_2Z_3 (c) XYZ (d) $X_6Y_3Z_2$
- 70 An ionic compound is composed of 29.08% sodium, 40.56% sulphur and 30.36% oxygen. What is the formula of sulphur ion in this compound ? [Na = 23, S = 32, O = 16]
- (a) $S_2O_3^{2-}$ (b) $S_2O_4^{2-}$ (c) $S_2O_5^{2-}$ (d) $S_2O_6^{2-}$
- 71 The molar mass of a compound = 88 g/mol
What is the probable empirical formula of this compound ? [C = 12, H = 1, O = 16]
- (a) CH_2 (b) CH_2O (c) CH_3O (d) C_2H_4O
- 72 From the equation : $CO_{2(g)} + Ca(OH)_{2(aq)} \longrightarrow CaCO_{3(s)} + H_2O_{(l)}$
What is the mass of calcium carbonate which is produced from passing CO_2 gas in 500 mL of 0.5 M $Ca(OH)_2$ solution ? [Ca = 40, C = 12, O = 16]
- (a) 15 g (b) 20 g (c) 25 g (d) 30 g
- 73 What is the volume of water which is required to be added to 2 L of 0.2 M solution of potassium hydroxide to form 0.05 M solution of it ?
- (a) 4 L (b) 6 L (c) 8 L (d) 10 L
- 74 What is the volume of water which is required to be added to 500 mL of a molar solution of table salt to form 0.1 M solution of it ?
- (a) 100 mL (b) 1000 mL (c) 4.5 L (d) 5 L
- 75 A beaker containing 230 mL of 0.275 M solution was placed on a hot surface, and after a period of time its concentration became 1.29 M
What is the volume of the solvent which is evaporated ?
- (a) 49 mL (b) 63.3 mL (c) 181 mL (d) 230 mL

Essay questions :

- 76 When 500 mL sample of 1 M sulphuric acid is left in an open place, a part of it evaporates, so its volume becomes 130 mL

Calculate the concentration of the acid after evaporation.

- 77 5.5 M solution of LiOH is diluted with water, so its volume changes from 45 mL to become 125 mL

Calculate the mass of LiOH found in 5 mL of the dilute solution. [Li = 7, O = 16, H = 1]



Choose the correct answer for the questions 1 : 20

20 marks

- 1 The mass of 1.12 L of gas (X) equals 6.23 g (at STP).

What is the molar mass of gas (X) ?

- (a) 56 g/mol (b) 89 g/mol (c) 124.6 g/mol (d) 140.6 g/mol

- 2 Which of the following contains the highest number of molecules ?

- (a) 1 g H_2 (b) 2 g N_2 (c) 4 g O_2 (d) 11 g CO_2
- [H = 1, N = 14, O = 16, C = 12]

- 3 In terms of the hypothetical equation :



On mixing 3 mol of substance (A) with 2 mol of substance (B).

Which of the following represents the limiting reactant ? Why ?

- (a) Substance (A), as its number of moles is higher than that of (B).
(b) Substance (A), as its moles are consumed completely.
(c) Substance (B), as its number of moles is less than that of (A).
(d) Substance (B), as its moles are consumed completely.

- 4 In terms of the reaction : $Fe_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_{2(g)}$

What is the mass of iron (II) chloride produced from the reaction of 28 g of iron with excess of hydrochloric acid ?

[Fe = 56, Cl = 35.5]

- (a) 26.5 g (b) 52.5 g (c) 63.5 g (d) 91.5 g

- 5 What is the mass of 3.01×10^{23} atoms of sodium ?

[Na = 23]

- (a) 46 g (b) 23 g (c) 11.5 g (d) 0.5 g

- 6 On burning 50 mL of the hydrocarbon C_xH_y in excess of oxygen gas, 200 mL of carbon dioxide gas and 250 mL of water vapour are formed (at STP).

What is the molecular formula of this hydrocarbon ?

- (a) C_2H_4 (b) C_3H_8 (c) C_4H_8 (d) C_4H_{10}

7 Of which of the following gases 0.25 mol equals 7 g ? [C = 12, H = 1]

- (a) C_2H_6 (b) C_2H_4 (c) C_3H_8 (d) C_3H_6

8 2.31 g sample of one of nitrogen oxides contains nitrogen of a mass equals 0.68 g
What is the empirical formula of this oxide? [N = 14, O = 16]

- (a) NO (b) N_2O (c) NO_2 (d) N_2O_4

9 The combustion of a hydrocarbon yields 2.2 g of CO_2
What is the mass of carbon in this hydrocarbon ? [C = 12, H = 1, O = 16]

- (a) 0.6 g (b) 1.1 g (c) 6 g (d) 8 g

10 2 g of KNO_3 salt (its molar mass is 101 g/mol) are dissolved in a suitable amount of water to form a solution whose volume = 0.5 L

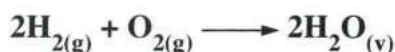
What is the molar concentration of the produced solution ?

- (a) 0.02 M (b) 0.04 M (c) 0.1 M (d) 0.2 M

11 If the formula of antimony oxide is Sb_2O_3 and that of sodium phosphate is Na_3PO_4 , so the formula of antimony phosphate is

- (a) $SbPO_4$ (b) Sb_2PO_4 (c) $Sb_2(PO_4)_3$ (d) Sb_3PO_4

12 10 g of hydrogen gas react with excess oxygen gas according to the equation :



What is the reacted volume of oxygen gas (at STP) and the mass of the produced water vapour from this reaction ? [H = 1, O = 16]

Choices	Reacted volume of O_2	Mass of H_2O
(a)	2.5 L	5 g
(b)	5 L	5 g
(c)	56 L	90 g
(d)	56 L	120 g

13 Which of the following samples has the largest mass ? [N = 14, H = 1]

- (a) 1 mol of N_2H_4 (b) 2 mol of N_2
(c) 3 mol of NH_3 (d) 25 mol of H_2

- 14 The molecular formula of a compound is X_4O_6 , 10 g of this compound contains 5.72 g of the element (X).

What is the relative atomic mass of element (X) ?

[O = 16]

- (a) 32 (b) 37 (c) 42 (d) 98

- 15 What is the volume of water which is required to be added to 0.45 L of 7.5 M solution to change its concentration to 5 M ?

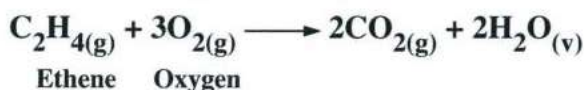
- (a) 0.225 L (b) 0.675 L (c) 0.115 L (d) 0.573 L

- 16 Two samples of oxygen and nitrogen gases have the same volume at the same conditions of pressure and temperature.

What is the similarity between these two gases ?

- (a) The number of the molecules. (b) The number of the ions.
(c) The number of the atoms. (d) The molar mass.

- 17 1 mol of ethene gas burns according to the equation :



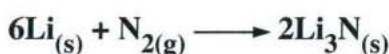
What is the number of the moles of the gases and the vapours which are found at the end of the reaction of 1 mol of ethene gas with 4 mol of oxygen gas ?

- (a) 2 mol (b) 3 mol (c) 4 mol (d) 5 mol

- 18 Which of the following formulas represents an empirical formula ?

- (a) N_2O_4 (b) C_3H_6 (c) NH_3 (d) P_4H_{10}

- 19 In the reaction :



What is the number of moles of lithium required to react with excess of nitrogen gas to produce 0.6 mol of lithium nitride ?

- (a) 0.2 mol (b) 0.3 mol (c) 0.4 mol (d) 1.8 mol

- 20 These are 3 samples of different gases (at rtp) :

- (1) 4 g of argon gas. (2) 3.2 g of oxygen gas.
(3) 4.4 g of carbon dioxide gas.

What is the correct relation between the volumes of these samples of the gases ?

- (a) Volume of sample (1) > Volume of sample (2).
(b) Volume of sample (2) > Volume of sample (3).
(c) Volume of sample (1) = Volume of sample (3).
(d) Volume of sample (3) > Volume of sample (1).

[Ar = 40 , O = 16 , C = 12]

Answer the essay questions 21 : 23

4 marks

- 21 Calculate the mass of ammonia gas NH_3 that has the same volume of 8 g of oxygen gas O_2 (at rtp). [N = 14, H = 1, O = 16]

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1 mark

- 22 From the reaction equation : $2\text{NH}_{3(g)} + 3\text{CuO}_{(s)} \longrightarrow 3\text{Cu}_{(s)} + 3\text{H}_2\text{O}_{(l)} + \text{N}_{2(g)}$

Calculate the volume of ammonia gas (at STP) which reacts completely with 6 g of copper oxide. [Cu = 63.5, O = 16]

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2 marks

- 23 An unknown compound contains 24.2% carbon, 4% hydrogen and the rest is chlorine.

What is the molecular formula of this compound ?

Given that its molar mass is 148.5 g/mol

[C = 12, H = 1, Cl = 35.5]

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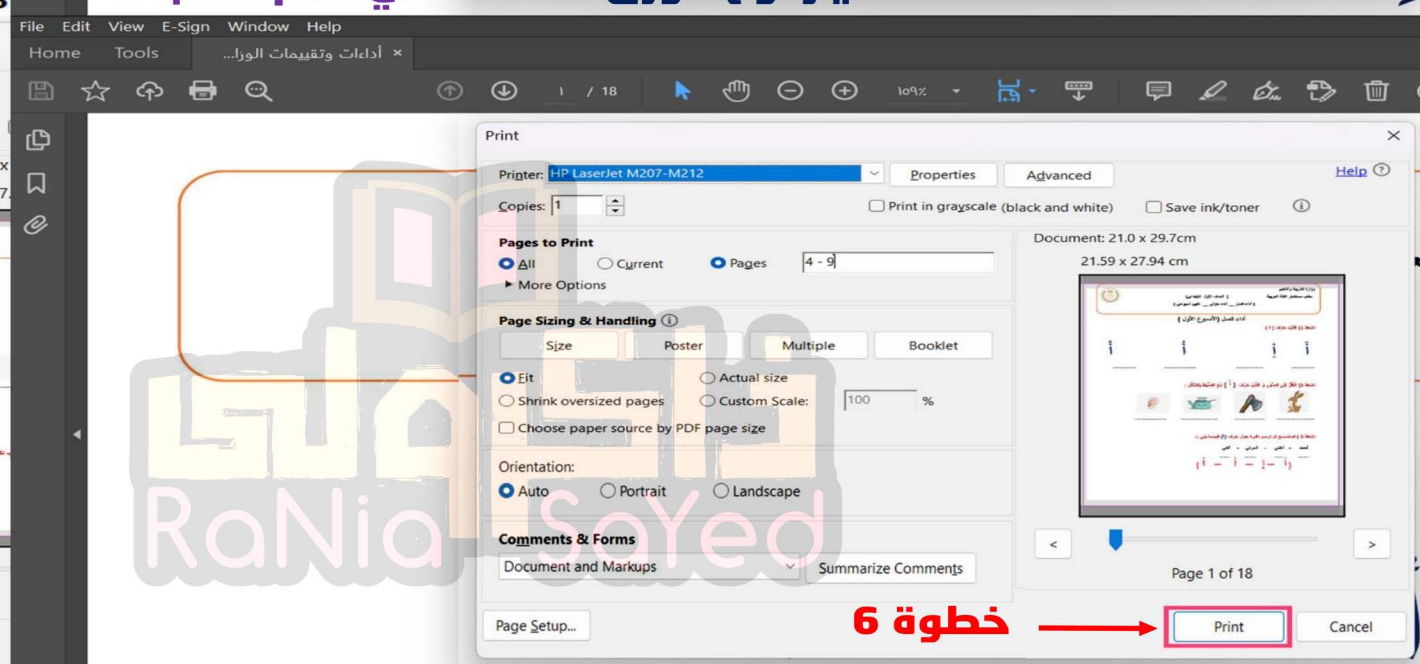
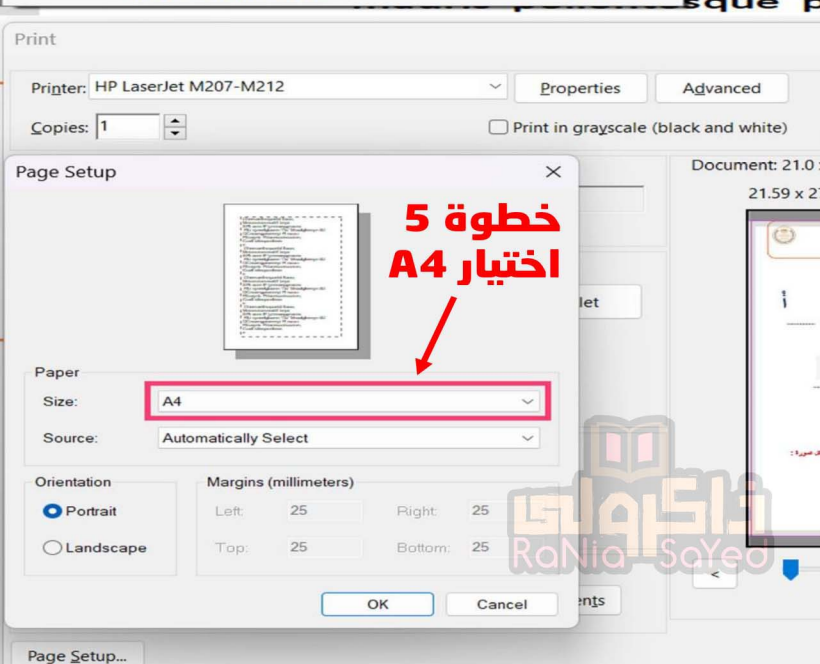
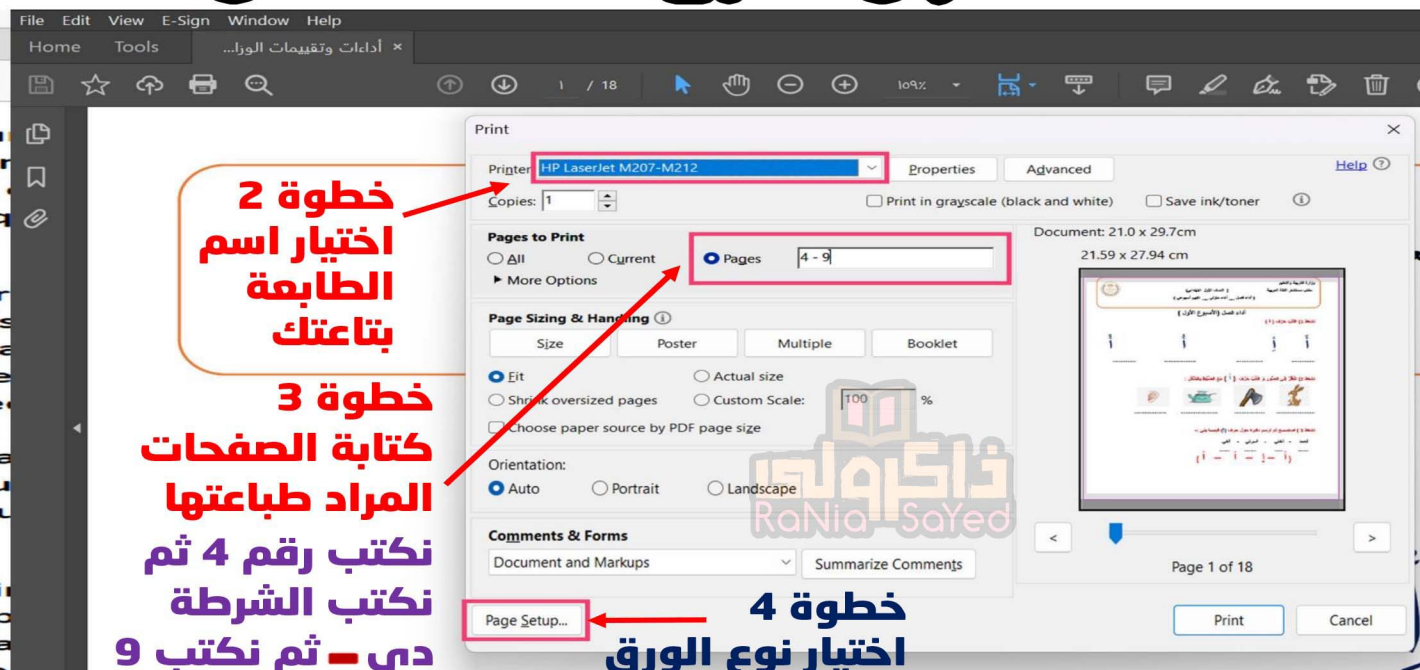
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1 mark

كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9



حمل الآن

مجاناً وحصرياً

المراجعة رقم (2)

اختبار شهر اكتوبر



Important Revision

The following table shows the valency of some metals

Element Monovalent Valency (+1)	Element Divalent Valency(+2)	Element Trivalent Valency (+3)
Lithium (Li) Sodium (Na) Silver (Ag) Potassium (K)	Mercury (Hg) Magnesium (Mg) Calcium (Ca) Lead (Pb) Iron (Fe) Copper (Cu)	Aluminum (Al) Iron (Fe) Gold (Au)

Table of atomic groups

Atomic group	Symbol	Valency	Atomic Group	Symbol	Valency
Hydroxide	OH^-	-1	Sulphate	SO_4^{-2}	-2
Nitrate	NO_3^-	-1	Carbonate	CO_3^{-2}	-2
Nitrite	NO_2^-	-1			
Bicarbonate	HCO_3^-	-1	Phosphate	PO_4^{-3}	-3
Ammonium	NH_4^+	+1			

The equation includes the physical states written at the bottom left of the chemical symbols.

Solid	S
Liquid	L
Gas	G
Aqueous solution	Aq

Chapter (1) :-The chemical calculation

The mole:

It is the amount of substance that contains Avogadro's number.

- If the substance is in the form of **atoms**, the mass of one atom is called **atomic mass**

It is very small and measured by **atomic mass unit (a.m.u.)**.

- If the atomic mass of carbon atom (C) = 12 a.m.u., then **one mole** of carbon atom = 12 **grams** of carbon atoms.
- If the substance is in the form of **molecules**, then the mass of one molecule is called **molecular mass**. It is equal to the sum of atomic mass of atoms forming this molecule.

Molar mass It is the sum of the atomic mass of the atoms forming the molecule.

Example:

Calculate the molecular mass of carbon dioxide (CO₂). If you know that the atomic mass of oxygen is 16 and carbon is 12.

Answer:

Molecular mass of CO₂ = (atomic mass of carbon) + (2 x atomic mass of oxygen)

$$= (12) + (2 \times 16)$$

$$= (12) + (32) = 44 \text{ a.m.u.}$$

One mole of CO₂ = 44 g

Example: Calculate the formula unit mass for ionic calcium chloride (CaCl_2).

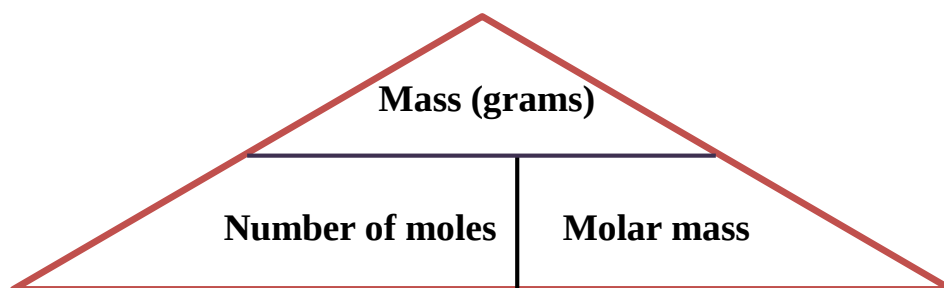
If you know that the atomic mass of calcium ion is 40 and chloride ion is 35.5 .

Answer:

$$\begin{aligned}\text{mass of CaCl}_2 &= (\text{mass of calcium ion}) + (2 \times \text{mass of chloride ion}) \\ &= (40) + (2 \times 35.5) \\ &= (40) + (71) = 111 \text{ a.m.u.}\end{aligned}$$

One mole of $\text{CO}_2 = 111 \text{ g}$

$$\text{Number of moles} = \frac{\text{mass of substance (gram)}}{\text{Mass of one mole of this substance (g/mol)}}$$



** The mass of a mole (molar mass) different from one matter to another.(G.R)*

Due to the difference in composition from one matter to another.

- The mole of molecules of monatomic element is different from the mole of the same element if it is diatomic.

*The molar mass of oxygen molecules = $16 \times 2 = 32 \text{ g}$

*The molar mass of oxygen atom = 16

The mole and Avogadro's number:

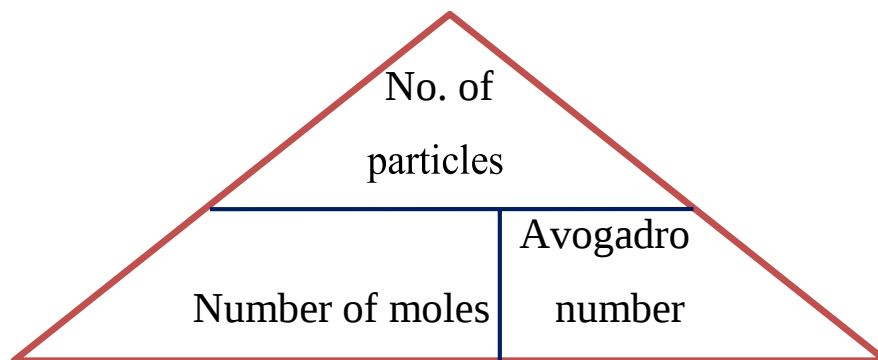
Avogadro reached that the number of atoms, molecules or ions found in one mole is a constant number whatever the form of substance.

Avogadro number = 6.02×10^{23}

Avogadro number:

It is the number of atoms, molecules or ions found in one mole of the substance and equals 6.02×10^{23} (atoms, molecules or ions).

$$\begin{array}{c} \square \square \square \square \square \square \square \square \square \square \square \\ = \end{array} \frac{\text{number of particles}}{\square \square \square \square \square \square \square \square \square \square \square}$$



Exercise (1):

Calculate the number of molecules of 2 mol of CO₂ gas.

Answer:

$$\begin{aligned}\text{Number of molecules} &= \text{number of moles} \times \text{Avogadro number} \\ &= 2 \times 6.02 \times 10^{23} = 12.04 \times 10^{23} \text{ molecules}\end{aligned}$$

Exercise (2):

Calculate the number of carbon atoms found in 50 g of calcium carbonates
[Ca = 40, C = 12, O = 16]

Answer:

$$1 \text{ mole of calcium carbonate } \text{CaCO}_3 = 40 + 12 + (16 \times 3) = 100 \text{ g}$$

$$1 \text{ mole } \text{CaCO}_3 \xrightarrow{\text{contains}} 1 \text{ mol of carbon atoms}$$

$$100 \text{ g } \text{CaCO}_3 \xrightarrow{\text{contains}} (6.02 \times 10^{23}) \text{ atoms}$$

$$50 \text{ g } \text{CaCO}_3 \xrightarrow{\text{contains}} \times \text{ carbon atoms}$$

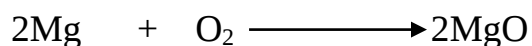
$$x = \frac{(6.02 \times 10^{23} \times 50)}{100} = 3.01 \times 10^{23} \text{ atom}$$



Exercise (3):

Calculate the number of magnesium oxide molecules produced from reaction of 24 grams of magnesium with excess amount of oxygen. [Mg = 24]

Answer:



$$2\text{moles} \longrightarrow 2 \text{ moles}$$

$$2 \times 24 = 48\text{g} \longrightarrow 2 \times 6.02 \times 10^{23}$$

$$24 \text{ g} \longrightarrow ??$$



$$\text{Number of magnesium oxide molecules} = \frac{24 \times 2 \times 6.02 \times 10^{23}}{48} = 6.02 \times 10^{23}$$

molecules.

The mole and the volume of gas

- Solid or liquid matter has a definite volume.
- The volume of gas equals the volume of the container it occupies
- The mole of any gas in standard temperature and pressure (STP) occupies a certain volume = 22.4 liters.

• (STP) means

1-Temperature equals 273 K or 0° C

2-pressure = 760 mmHg (normal atmospheric pressure = 1 atm.)

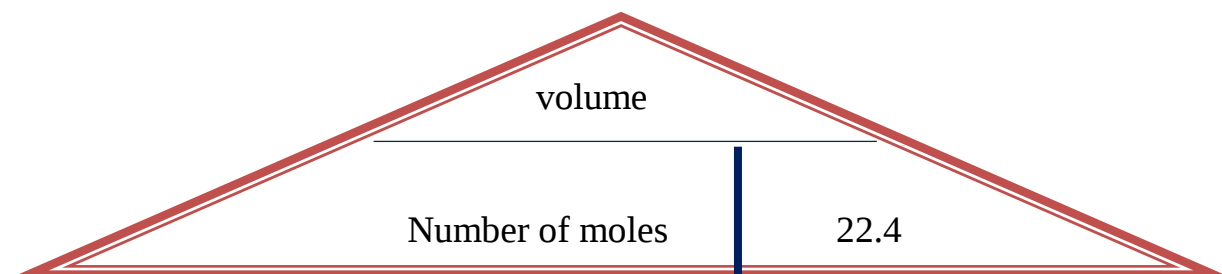
3-Concentration = 1 molar

volume

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Example(1):

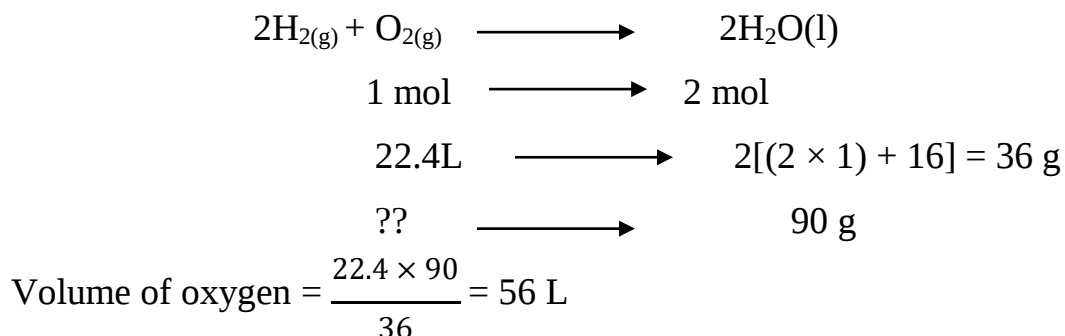
Calculate the volume of 3 moles of oxygen gas

Answer:

$$\text{Volume} = \text{number of moles} \times 22.4 = 3 \times 22.4 = 67.2 \text{ L}$$

Example(2): Calculate the volume of oxygen needed to produce 90 g of water by reacting with an excess amount of hydrogen at the standard temperature and pressure (STP) [H = 1, O = 16]

Answer:



Avogadro Hypothesis:

Equal volume of different gases contain the same number of molecules under the same standard temperature and pressure (STP).

			
Volume:	22.4 L	22.4 L	22.4 L
Pressure:	1 atm	1 atm	1 atm
Temperature:	273 K	273 K	273 K
Quantity:	1 mole	1 mole	1 mole
Mass:	40.0 g	32.0 g	28.0 g

Volume of gas at (rtp)

Means at room temperature 25°C (298K), normal atmospheric pressure.

$$\text{Volume of gas at (rtp)} = \text{no. of moles} \times 24$$

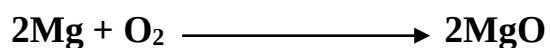
Limiting reactant

Limiting reactant

It is the reactant which is completely consumed during chemical reaction

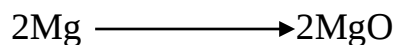
Example:

When magnesium reacts with oxygen according to the equation



What is limiting reactant when 32 g of oxygen reacts with 12 g of magnesium?

[Mg = 24 , O=16]

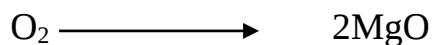


2moles 2moles

$2 \times 24 = 48\text{g}$ $2(24+16) = 80\text{g}$

12g ??

Mass of magnesium oxide = 20 g



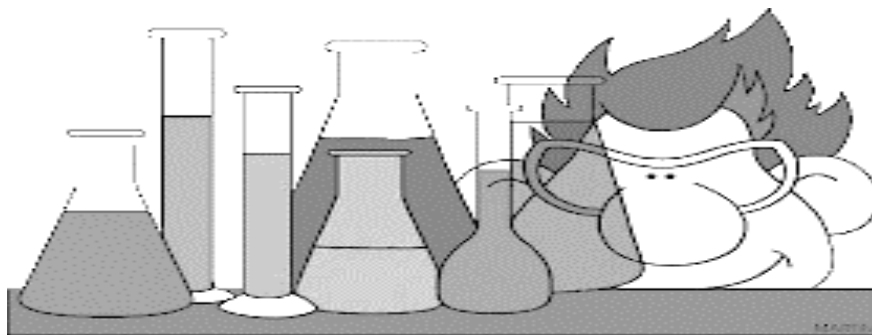
1 moles 2 moles

32 g 80 g

32 g ??

mass of magnesium oxide = 80 g

Limiting reactant is magnesium



Calculation of chemical formula

Empirical formula:

A formula expressing the simplest ratio of true numbers between the atoms of elements which formed the compound.

Example:

The molecular formula of propylene is C_3H_6 ----- That means that the molecule of propylene is formed of 6 atoms of hydrogen and 3 atoms of carbon with ratio of 6(H) : 3(C).

By simplifying this ratio to its true value the ratio becomes

2 (H) : 1 (C) so the empirical formula is CH_2

-
- Sometimes the empirical formula is similar to chemical formula like (carbon dioxide CO_2) – (Nitric oxide NO)
 - The empirical formula of two different compounds may be the same like acetylene C_2H_2 and benzene C_6H_6 . Both of them has empirical formula (CH)
 - The empirical formula of the compound can be calculated in terms of weight percentage of elements that represent that mass of elements found in 100 g



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Example:

Calculate the empirical formula of a compound containing nitrogen with a weight percentage of 25.9 % and oxygen with a weight percentage of 74.1 % knowing that (N = 14 , O = 16)

Answer:

	N	:	O	
Number of moles	$\frac{25.9}{14}$	:	$\frac{74.1}{16}$	
	1.85	:	4.63	
	$\frac{1.85}{1.85}$	:	$\frac{4.63}{1.85}$	
	1	:	2.5	(x 2)

The empirical formula is N₂O₅

Molecular formula:

Is a symbolic formula of the molecule of the element, or molecule or formula unit. It express the actual type and number of atoms or ions that form this molecule or unit.

$$\text{Number of units of the emperical formula} = \frac{\text{molar mass of the compound}}{\text{molar mass of the emperical formula}}$$

Example:

Chemical analysis of acetic acid prove that it is formed from 40% carbon, 6.67% hydrogen , and 53.33% oxygen. If the molecular molar mass of it is 60g find the molecular formula of the acid knowing that (C= 12, H=1, O=16)

Answer:

Number of moles =	C	H	O
	$\frac{40}{12}$	$\frac{6.67}{1}$	$\frac{53.33}{16}$

3.33

6.67

3.33

Divide on the smallest number of moles

Ratio = 1 : 2 : 1

Empirical formula is CH_2O

Molecular mass of empirical formula = $16 + (1 \times 2) + 12 = 30 \text{ g}$

Number of units of empirical formula = $\frac{60}{30} = 2$

Molecular formula is $\text{CH}_2\text{O} \times 2 = \text{C}_2\text{H}_4\text{O}_2$

Concentration of the solution

1-Molarity

It is the number of solute moles that dissolved in one liter of solution

Unit : (Mol / L) or molar (M)

$$\text{Molarity} = \frac{\text{Number of solute moles (mol)}}{\text{solution volume}}$$

Example: Calculate the molarity of sugar cane solution $\text{C}_{12}\text{H}_{22}\text{O}_{12}$ in water, if you knew that the mass of the dissolved sugar is 85.5 g in a solution volume of 0.5 L (C = 12, H=1, O=16).

Answer:

Molar mass of sugarcane = $(12 \times 12) + (1 \times 22) + (12 \times 16) = 358 \text{ g/mol}$

Number of moles = mass / molar mass = $(85.5) / (358) = 0.24 \text{ mol}$

$$\text{Molarity} = \frac{\text{Number of moles (mole)}}{\text{Solution volume}} = \frac{0.24}{0.5} = 0.47 \text{ mol/liter}$$

Dilution of solution:-

$$\begin{array}{ccc} \mathbf{M_1 \times V_1} & = & \mathbf{M_2 \times V_2} \\ \text{before dilution} & & \text{after dilution} \end{array}$$

M :- molar concentration

V :-volume



كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9

